

TOP SECRET

Talent-Keyhole  
CONTROL SYSTEM ONLYWORKING PAPER  
26 November 1963

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Referral review completed by NIMA 3/1/01  
Referral review completed by NIMA 3/1/01KH-4 SUN ANGLE STUDY

The KH-4A system has a single slit which is set for optimum conditions before each flight. This slit is set for the average light conditions which generally occur at, or near, 37-45 degrees sun angle. The KH-4A system provides some exposure control due to changing scan rate. At higher altitudes, the scan rate is slower and, therefore, the exposure increases. The average light conditions within the target area are used in the KH-4A computation.

The KH-4B camera system has a commandable slit that can occupy any slit width between .134 inches and .349 inches.

The exposure time is a function of scan rate and slit width, therefore, exposure is a function of altitude, since scan rate is a function of altitude. Altitude changes are relatively small (approximately 20%) and produce some exposure control; however, slit width change can control large exposure variables.

There are some residual smears that occur when a wide slit is used but this is a very small percent of the actual ground resolution.

The sun angle does not become significant under normal circumstances until a lower limit of 20 degrees is reached. For instance, the number of foot-lamberts of incident light at 60 degrees is approximately 750, while at 20° it is 430 foot-lamberts. This is a decrease of 43%. To attain comparable photography, the slit would have to be widened from .150 (nominal) to .214 inches to take care of the decrease in light. In like manner, going from 20° to 7° the decrease is only 16% and the slit needs only to be widened to .248 inches to take care of this change in light conditions.

Below 7°, the accuracy of the computations becomes much worse because the curves tend to become nearly asymptotic. Note, in Diagram 1, that the position of maximum change in light conditions starts at approximately 7°. However, when discussing exposure value, as in Diagram 3 and 4, the effective exposure change due to slit width is more apparent. Note that exposure change can be accomplished by slit change or processing level. In the lower sun angle cases, the processing level has less effect and the exposure change should be accommodated by slit changes.

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GROUP 1  
Excluded from automatic  
downgrading and  
declassification

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Film emulsion also has a decided effect on the exposure of the film. The 60 230 has an exposure index of 2.4 while the present 3404 has an index of 1.6. This represents an average increase of light sensitivity of 1.5. This means that a faster emulsion can supply broader exposure ranges in low sun-angle conditions.

Sun angle experiments have been accomplished on numerous past missions with the most pertinent data coming from Mission 1029. In this case, interpretable imagery was acquired at 1° sun angle below the snow line. Imagery acquired at 1.45° sun angle above the snow line had adequate exposure. Equating this test data to the KH-4B system, it should be possible to acquire interpretable imagery at +40 minutes sun angle below the snow line. Interpretable imagery can be attained at about -1.5 degrees sun angle when above the snow line and adequate exposure occurs at 1° sun angle above the snow line.

It should be understood that foot-lamberts of light available vary with terrain, vegetation, and cloud shadows. The numbers represented here are minimum figures for nominal conditions and can vary widely with the conditions.

Some graphics are attached showing the average light conditions and exposure values for different sun angles.

25X1A

25X1A

Attachments:  
Graphics (4)

References:

- a. OXC 0318-67  
Type IIC Equipment
- b. [REDACTED]-69547/67  
J-5 Camera System Design
- c. ICL-TCS-042-68  
KH-4B System Capability

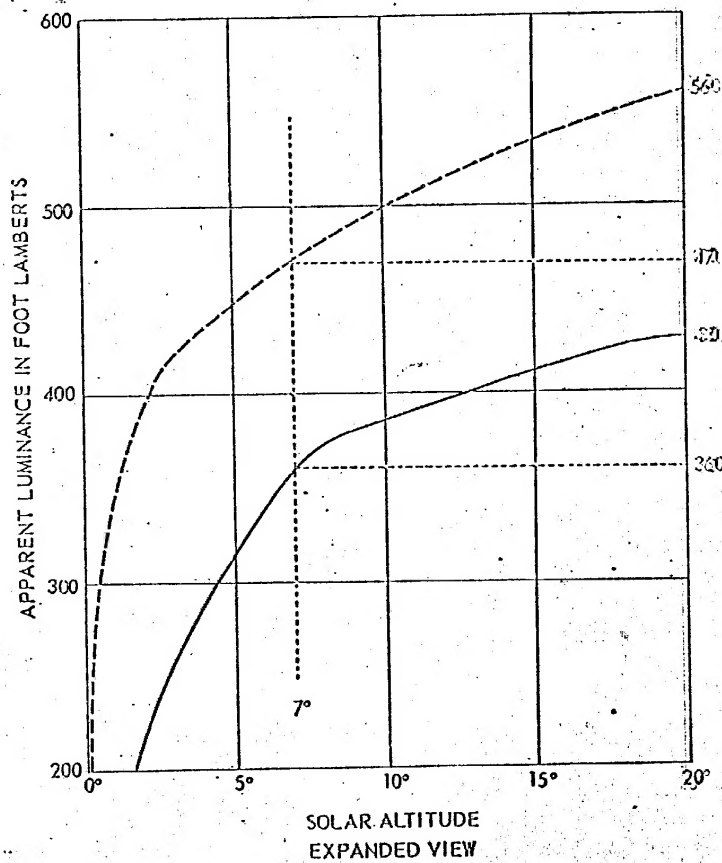
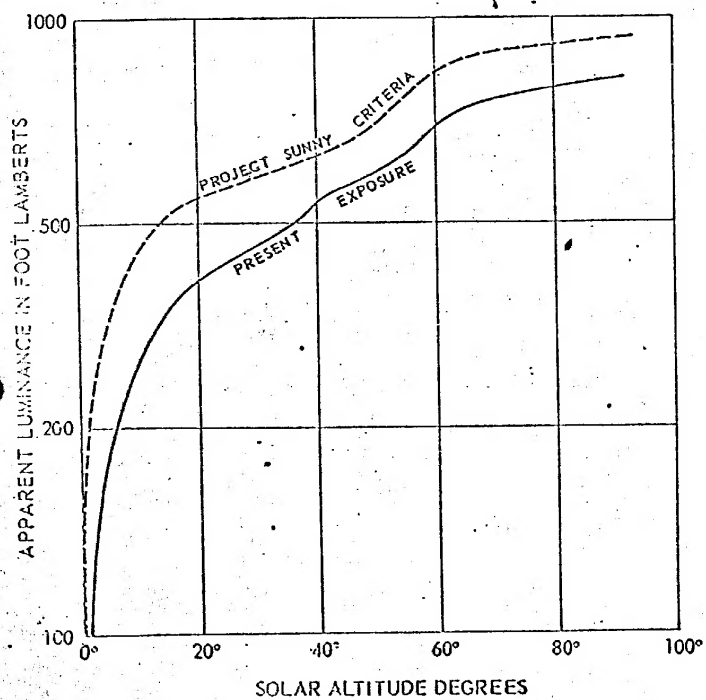
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DIAGRAM 1



NOTE: The Luminance Loss between 20-degree Sun Angle and 7-degree Sun Angle is 16%

DIAGRAM 2

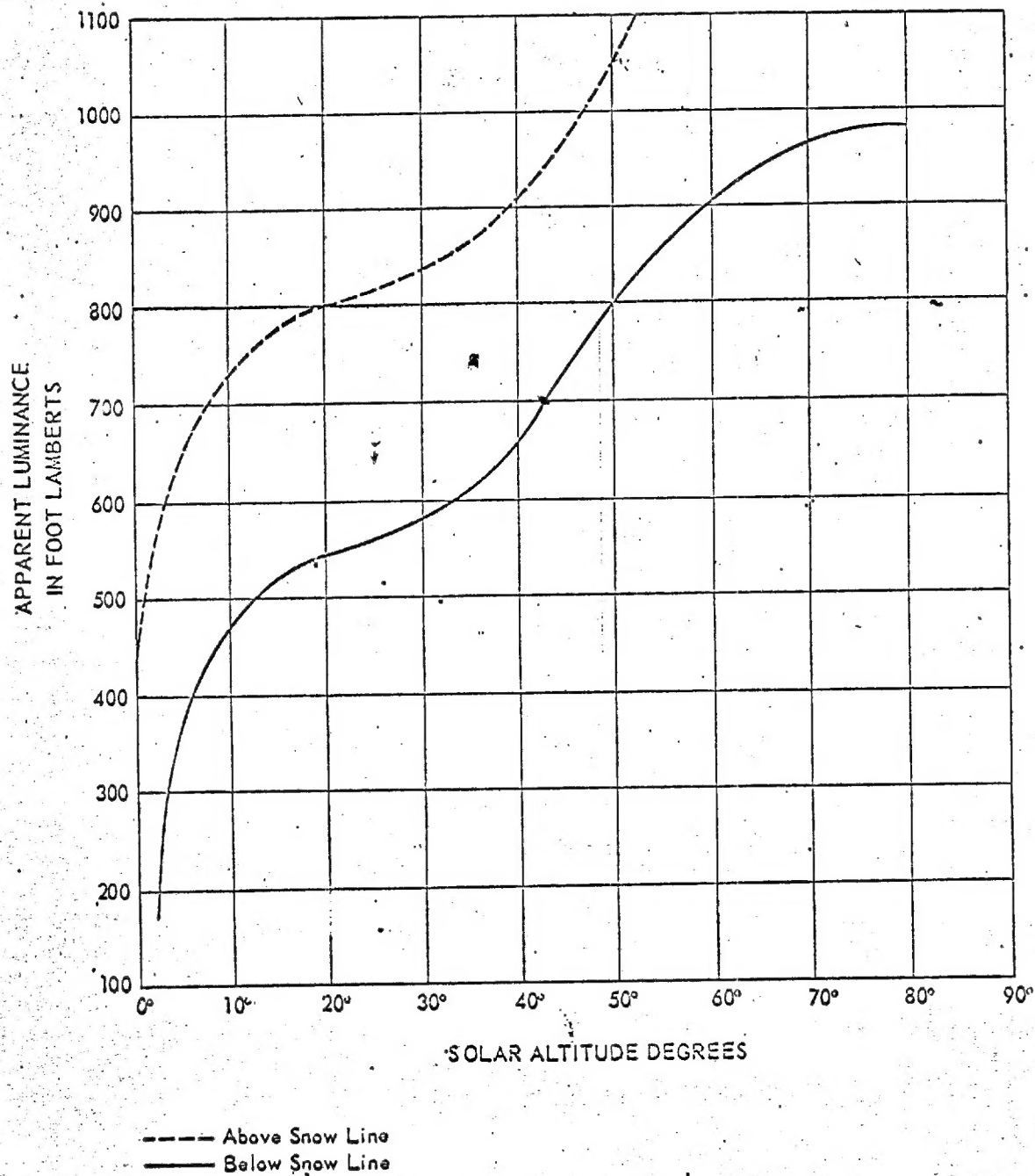
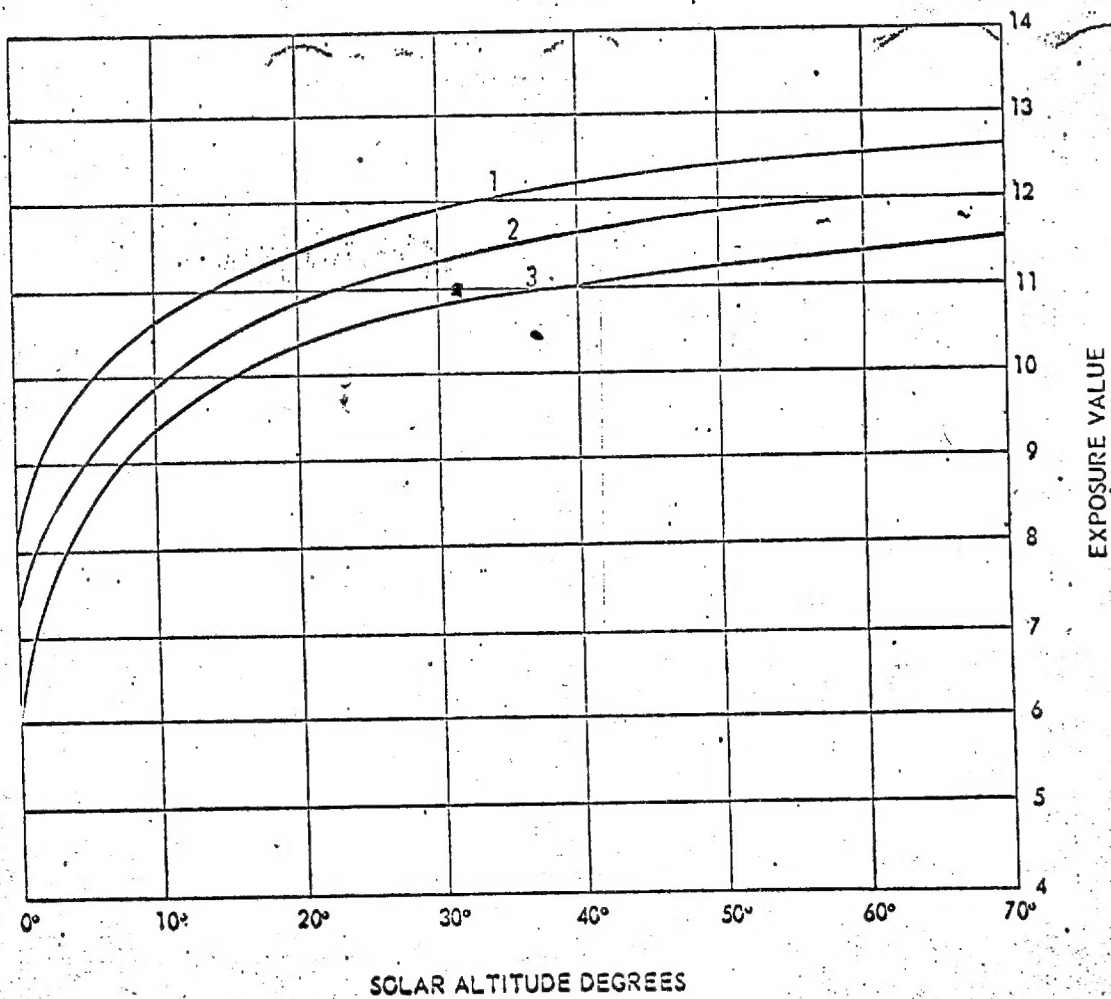


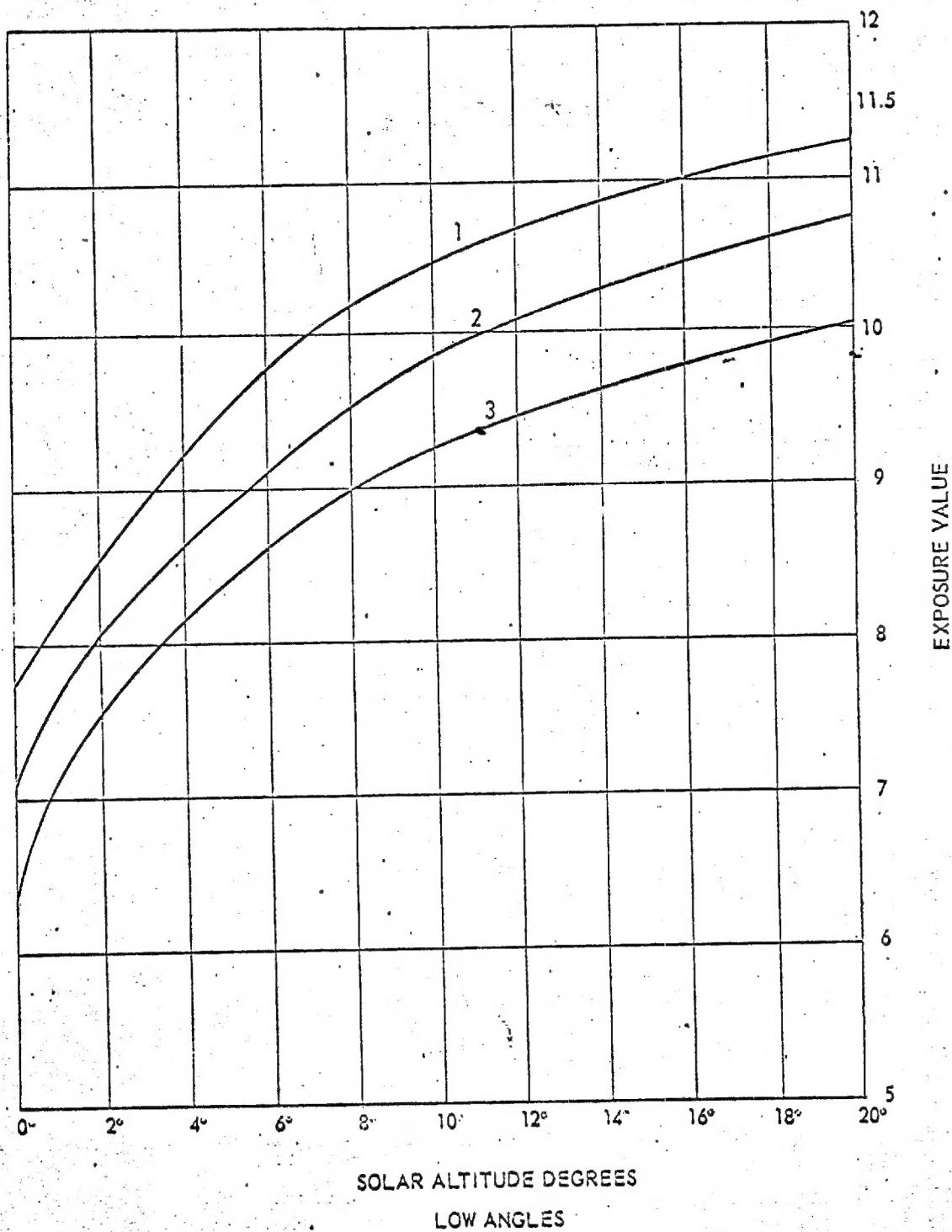
DIAGRAM 3



- 1 = Full Processing
- 2 = Intermediate Processing
- 3 = Primary Processing



DIAGRAM 4



- 1 = Full Processing
- 2 = Intermediate Processing
- 3 = Primary Processing